Bulletin of

# Volcanology

Journal of the International Association of Volcanology and Chemistry of the Earth's Interior

## Volume 52 1989/90

**Executive Editors**

H.-U. Schmincke
GEOMAR
Wischhofstrasse 1-3
D-2300 Kiel, FRG

R. S. J. Sparks
Department of Geology
Wills Building
University of Bristol
Bristol BS8 1RJ, UK

**Editorial Board**

B. F. Houghton
DSIR Geology and
Geophysics
P.O. Box 499
Rotorua, New Zealand

C. Jaupart
Institut de Physique
du Globe (P6)
Université de Paris 6 et 7
4, place Jussieu, Tour 14-15
F-75252 Paris Cedex 05
France

H. Kanamori
Seismological Laboratory 252-21
California Institute of
Technology
Pasadena, CA 91125, USA

Y. Katsui
Department of Geology
University of Hokkaido
Sapporo N10W8060, Japan

P. W. Lipman
U.S. Geological Survey
Box 25046, MS 913
Denver Federal Center
Denver, CO 80225, USA

G. A. Mahood
Stanford University
Department of Geology
School of Earth Sciences
Stanford, CA 94 305-2115
USA

H. Sigurdsson
Graduate School of
Oceanography
University of Rhode Island
Kingston, RI 02881, USA

**Springer**
**International**

*Bulletin of Volcanology* was founded in 1922, as *Bulletin Volcanologique*, and is the official journal of the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI). Beginning with Volume 48 (1986), the journal has been published by Springer International and edited by H.-U. Schmincke and S. R. J. Sparks

---

**Copyright**

Submission of a manuscript implies: that the work described has not been published before (except in the form of an abstract or as part of a published lecture, review, or thesis); that it is not under consideration for publication elsewhere; that its publication has been approved by all coauthors, if any, as well as by the responsible authorities at the institute where the work has been carried out; that, if and when the manuscript is accepted for publication, the authors agree to automatic transfer of the copyright to the publisher and that the manuscript will not be published elsewhere in any language without the consent of the copyright holders.

All articles published in the journal are protected by copyright, which covers the exclusive rights to reproduce and distribute the article (e.g., as offprints), as well as all translation rights. No material published in this journal may be reproduced photographically or stored on microfilm, in electronic data bases, video disks, etc., without first obtaining written permission from the publisher.

The use of general descriptive names, trade names, trademarks, etc., in this publication, even if not specifically identified, does not imply that these names are not protected by the relevant laws and regulations.

While the advice and information in this journal is believed to be true and accurate at the date of its going to press, neither the authors, the editors, nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express, or implied, with respect to the material contained herein.

*Special regulations for photocopies in the USA:* Photocopies may be made for personal or inhouse use beyond the limitations stipulated under Section 107 or 108 of U.S. Copyright Law, provided a fee is paid. This fee is US $ 0.20 per page, or a minimum of US $ 1.00 if an article contains fewer than five pages. All fees should be paid to the Copyright Clearance Center, Inc., 21 Congress Street, Salem, MA 01970, USA, stating the ISSN, the volume, and the first and last page numbers of each article copied. The copyright owner's consent does not include copying for general distribution, promotion, new works, or resale. In these cases, specific written permission must first be obtained from the publisher.

*Other regulations:* Authors publishing in this journal can, under certain conditions, benefit from library and photocopy fees collected by VG WORT. Authors resident in the Federal Republic of Germany or in West Berlin can apply to Verwertungsgesellschaft WORT, Abteilung Wissenschaft, Goethestraße 49, D-8000 München 2, for detailed information.

**Printers**
Zechnersche Buchdruckerei, W-6720 Speyer
© Springer-Verlag Berlin Heidelberg 1990
Printed in Germany

# ontents of volume 52 1989/90

. 1   1–80   issued in October 1989
. 2   81–158   issued in December 1989
. 3   159–246   issued in January 1990
. 4   247–324   issued in March 1990
. 5   325–412   issued in May 1990
. 6   413–506   issued in August 1990
. 7   507–576   issued in September 1990
. 8   577–650   issued in November 1990

en RL → Cas RAF   159
nmann M, Burtscher H: Characterization of ultrafine aerosol particles in Mt. Etna emissions   577
derson AT → Sahagian DL   49
dres RJ, Kyle PR, Stokes JB, Rose WI: $SO_2$ from episode 48A eruption, Hawaii: sulfur dioxide emissions from the episode 48A East Rift Zone eruption of Kilauea volcano, Hawaii   113
din J, Vellutini PJ, Coulon C, Piguet P, Vincent J: The 1928–1929 eruption of Kammourta volcano – Evidence of tectono-magmatic activity in the Manda-Inakir rift and comparison with the Asal Rift, Afar depression, Republic of Djibuti   551
xter PJ: Medical effects of volcanic eruptions. I. Main causes of death and injury   532
dnarz U, Schmincke H-U: Evolution of the Quaternary melilite-nephelinite Herchenberg volcano (East Eifel)   426
ake S → Koyaguchi T   127
ok and video review   570
udal C → Robin C   391
iggs PH → Symonds RB   355
üstle W → Seidl D   460
ll SW → Cas RAF   159
rtscher H → Ammann M   577
rr ML → Self S   57
s RAF, Allen RL, Bull SW, Clifford BA, Wright JV: Subaqueous, rhyolitic dome-top tuff cones: a model based on the Devonian Bunga Beds, southeastern Australia and a modern analogue   159
apin CE → McIntosh WC   584
evallier L, Verwoerd WJ: Influence of temperature on the distribution of stress and displacement in a volcano: a numerical approach   413
ristiansen RL → McPhie J   334
fford BA → Cas RAF   159
le JW: Structural control and origin of volcanism in the Taupo volcanic zone, new Zealand   445
ulon C → Audin J   551
lrymple GB → Duffield WA   475
ffield WA, Dalrymple GB: The Taylor Creek Rhyolite of New Mexico: a rapidly emplaced field of lava domes and flows   475
orak JJ: Geometry of the September 1971 eruptive fissure at Kilauea volcano, Hawaii   507
urisin D, Savage JC, Fournier RO: Recent crustal subsidence at Yellowstone Caldera, Wyoming   247
ke RS, Shepherd JB: Twelve years of ground-tilt measurements on the Soufrière of St. Vincent, 1977–1989   227
um   66, 562
urnier RO → Dzurisin D   247
ncis PW → de Silva SL   286
rcia MO, Ho RA, Rhodes JM, Wolfe EW: Petrologic constraints on rift-zone processes. Results from episode 1 of the Puu Oo eruption of Kilauea volcano, Hawaii   81
) → Hoffmann JP   522
rlach TM → Symonds RB   355
erti G, Wilson L: The influence of geometry on the ascent of magma in open fissures   515
Harmon RS → Symonds RB   355
Hegre JA → Nelson SA   186
Henry CD, Price JG: The Christmas Mountains caldera complex, Trans-Pecos Texas. Geology and development of a laccocaldera   97
Ho RA → Garcia MO   81
Hoblitt RP → Yamaguchi DK   545
Hoffmann JP, Ulrich GE, Garcia MO: Horizontal ground deformation patterns and magma storage during the Puu Oo eruption of Kilauea volcano, Hawaii: episodes 22–42   522
Houghton BF, Schmincke H-U: Rothenberg scoria cone, East Eifel: a complex Strombolian and phreatomagmatic volcano   28
IAVCEI News   78, 158, 246, 324, 412, 494, 575, 649
Kamata H → Suzuki-Kamata K   325
Kedzie LL → McIntosh WC   584
Keller J, Krafft M: Effusive natrocarbonatite activity of Oldoinyo Lengai, June 1988   629
Keskinen M → Kodosky L   175
Kirbani SB → Seidl D   460
Kodosky L, Keskinen M: Fumarole distribution, morphology, and encrustation mineralogy associated with the 1986 eruptive deposits of Mount St. Augustine, Alaska   175
Komorowski J-C → Robin C   391
Koyaguchi T, Blake S: The dynamics of magma mixing in a rising magma batch   127
Krafft M → Keller J   629
Kyle PR → Andres RJ   113
Lawrence DB → Yamaguchi DK   545
Major JJ, Newhall CG: Snow and ice perturbation during historical volcanic eruptions and the formation of lahars and floods. A global review   1
McIntosh WC, Sutter JF, Chapin CE, Kedzie LL: High-precision $^{40}Ar/^{39}Ar$ sanidine geochronology of ignimbrites in the Mogollon-Datil volcanic field, southwestern New Mexico   584
McPhie J, Walker GPL, Christiansen RL: Phreatomagmatic and phreatic fall and surge deposits from explosions at Kilauea volcano, Hawaii, 1790 A.D.: Keanakakoi Ash Member   334
Moore JG, Normark WR, Szabo BJ: Reef growth and volcanism on the submarine southwest rift zone of Mauna Loa, Hawaii   375
RB: Volcanic geology and eruption frequency, São Miguel, Azores   602
Mossand P → Robin C   391
Nelson SA, Hegre JA: Volcán Las Navajas, a Pliocene-Pleistocene trachyte/peralkaline rhyolite volcano in the northwestern Mexican volcanic belt   186
Newhall CG → Major JJ   1
Normark WR → Moore JG   375
Nye CJ, Turner DL: Petrology, geochemistry, and age of the Spurr volcanic complex, eastern Aleutian arc   205
Piguet P → Audin J   551
Price JG → Henry CD   97
Rampino MR → Self S   57
Rhodes JM → Garcia MO   81
Robin C, Komorowski J-C, Boudal C, Mossand P: Mixed-magma pyroclastic surge deposits associated with debris avalanche deposits at Colima volcanoes, Mexico   391

Rose WI → Andres RJ 113
Rose WI → Symonds RB 355
Rowland SK, Walker GPL: Pahoehoe and aa in Hawaii: volumetric flow rate controls the lava structure 615
Rubin AM: A comparison of rift-zone tectonics in Iceland and Hawaii 302
Sahagian DL, Anderson AT, Ward B: Bubble coalescence in basalt flows: comparison of a numerical model with natural examples 49
Savage JC → Dzurisin D 247
Schmincke H-U → Bednarz U 426
Schmincke H-U → Houghton BF 28
Schmincke H-U → Schumacher R 271
Schumacher R, Schmincke H-U: The lateral facies of ignimbrites at Laacher See volcano 271
SEAN Summary of recent volcanic activity 74, 242, 320, 404, 488, 573, 646
Seidl D, Kirbani SB, Brüstle W: Maximum entropy spectral analysis of volcanic tremor using data from Etna (Sicily) and Merapi (central Java) 460
Self S, Rampino MR, Carr MJ: A reappraisal of the 1835 eruption of Cosigüina and its atmospheric impact 57
Shepherd JB → Fiske RS 227
de Silva SL, Francis PW: Potentially active volcanoes of Peru – Observations using Landsat Thematic Mapper and Space Shuttle imagery 286
Stokes JB → Andres RJ 113
Sutter JF → McIntosh WC 584
Suzuki-Kamata K, Kamata H: The proximal facies of the Tosu pyroclastic-flow deposit erupted from Aso caldera, Japan 325
Symonds RB, Rose WI, Gerlach TM, Briggs PH, Harmon
Evaluation of gases, condensates, and $SO_2$ emissions
Augustine volcano, Alaska: the degassing of a Cl-rich
canic system 355
Szabo BJ → Moore JG 375
Takada A: Magma transport and reservoir formation by a
tem of propagating cracks 118
Turner DL → Nye CJ 205
Ulrich GE → Hoffmann JP 522
Vellutini PJ → Audin J 551
Verwoerd WJ → Chevallier L 413
Vignaux M, Weir GJ: A general model for Mt. Ruapeh
hars 381
Vincent J → Audin J 551
Waitt RB: Swift snowmelt and floods (lahars) caused by
pyroclastic surge at Mount St Helens volcano, Washin
18 May 1980 138
Walker GPL → McPhie J 334
Walker GPL → Rowland SK 615
Ward B → Sahagian DL 49
Weir GJ → Vignaux M 381
Wilson L → Giberti G 515
Wolfe EW → Garcia MO 81
Wright JV → Cas RAF 159
Yamaguchi DK, Hoblitt RP, Lawrence DB: A new tree-ring
for the "floating island" lava flow, Mount St. Helens, W
ington 545

Subject index V
List of locations XI

*Indexed in Current contents*

# Subject index of volume 52 1989/90

lava 552, 615
AS 223
lation rate of snowpack 23
cretionary lapilli 102, 334, 342, 426
id vapors 175
tive rifts 302
tive volcanoes 286
lventive vents 635
enigmatite 193
eolian deposits 348
erosols 63, 577, 578
ges -anomalous plateau ages 584
glutinate 33, 426
glutinated spatter 61
rfall deposits 97, 100, 140
rborne COSPEC measurements 355
abandite 638
bedo 291
bite 415
kali feldspar 192
kali-basalt cinder cones 602
kalic magma belts 97
kaline basalt 186, 553
nphibole 205
alysis of volcanic tremor 460
desite 135, 175, 205, 286, 355, 391,
545, 585
desite/dacite volcano 356, 445
desitic magma 57
desitic volcano 382
hydrite 175
karamite 603
nual tree rings 547
orthite 85
Ar/$^{39}$Ar age spectra 584
Ar/$^{39}$Ar laser dating 427
gon, excess 584
gon, loss 584
fvedsonite 193
cent velocity 515
h 296, 325
h clouds 271
h fall 58, 143, 176
h flow 186, 205
h flow transport 271
h flow tuff 97, 207
phyxia 532
tenospheric mantle 206
thenospheric relaxation 259
mospheric argon 209
mospheric impact 57
mospheric implications 116
mospheric perturbation 63
mospheric pressure indicator 54
mospheric samples 175
omic ratios 360
gite 83, 191
tobrecciation 171
tocorrelation functions 463
alanche caldera 391

ck arc extension 451
ck-arc basin 445

background channel flow 382
ballistic blocks 275
basalt 160, 247, 396, 417, 445
basalt dikes 99
basalt flow, solidification of 50
basaltic andesites 396
basaltic cone 551
basaltic eruptions 113
basaltic lava flow 49, 476
basaltic magma 118, 370, 515
basanite 427
base surge 441
batholith 97, 207
bathymetry, offshore 377
bench marks 227
Benioff zone 176
Benioff zone seismicity 206
benmoreite 186
Bezymianny type debris aval-
anche 391
Bezymianny-type eruption 207
biotite 193, 475
blast of hot gas 16
block faulting 451
body forces 417
bomb beds 31
bomb sags 275
Bouguer gravity anomaly 206, 262
boundary condition, remote 423
breadcrust 35
breccia 105
breccia facies 325
bubble coalescence 49, 443
bubble velocity 50
bubble volume 54
bulk deposit volume 336
bulk vesicularity 50
bulk volume (DRE) 57, 326, 426
buoyancy 119
buoyancy forces 127

$^{14}$C age 391
calc-alkaline 176, 205
calc-alkaline volcano 186
caldera 97, 325, 401, 451, 475, 602
caldera collapse 97, 247
caldera formation 186, 188, 205, 445
caldera rim 334
caldera wall 391
caldera-outflow deposit 603
carapace 61
carbonate globules 427
carbonatite volcano 629
carbonatitic lava lake 633
carbonized tree log 61
cataclysmal episode 401
cataclysmic ash-flow eruption 247
catastrophic event 391
catastrophic flank collapse 400
catastrophic flood 1, 138
catastrophic lahars 1
cathodoluminescence 638
cauliflower bombs 391

centers for disease control 534
central vent 325
channel slope 381
channelized flow 615
charred wood 138, 548
Chezy-law 384
chlorine 175
cinder cone 113, 186, 187, 196, 551
cirumferential stress 420
chlorine 355
clast morphology 36
clast-rotated texture 163
clastogenic lava 57
climatic effects of explosive volcan-
ism 57
climatic scale 116
climatic trends 63
climbing spectra 591
clinopyroxene 205, 391, 553
co-ignimbrite ash 271
CO$_2$ 114
coagulation 579
coalescence model 50
collapse of roofs 537
column collapse 97, 325, 331
column of magma 314
columnar jointed basalt flow 200
combeite 629
comenditic rhyolite 187
compatible element 81
component analysis 36, 395
component proportions 335
composite cone 286
compositional zoning 97
compressive strain 264
compressive stress 118, 419, 507
condensate 355, 577
condensation particles 577
conductive heat loss 521
conductive process 415
conduit 127
conduit geometry 515
conical shear fracture 424
contact metamorphism 415
contamination 219, 584
continental margin 287
continental red bed 160
continental rift 453
convective process 415
convergent plate volcano 355
convergent-margin stratovolcano 228
corona charger 578
correlation spectrometer (COS-
PEC) 113, 358
crack propagation 118
crater collapse 429
crater collapse tectonics 442
crater facies 31
crater lake 17, 155
crater lake volume 382
crater unconformity 436
crater-fill facies 34
Cretaceous rocks 99

crustal assimilation 445
crustal movements 266
crustal structure of arcs 447
crustal structure of back arc basins 447
crustal subsidence 247
cryptoperthitic exsolution 587
crystal fractionation 81, 417
crystallization 93, 247

dacite 135, 142, 391
dacite dome 286
dacite volcano 445
dacitic magma 370
data reduction methods 115, 229
dead:injured ratio 532
death and injury, main causes of 532
debris avalanche 205, 477
debris avalanche deposit 391
debris flow 15, 103, 159, 160
decompression 516
decompressive volume expansion 51
deep water basin 160
deep-water massflow 159
deep-water sediment 159
deflation/inflation cycle 227
deformation data 227
deformation pattern 233
deformation record 523
degassing 50, 175, 334, 355
dehydration cracks 181
dendrochronology 546
dense rock equivalent volumes (DRE) 62, 177, 272, 332, 475, 529
density determinations 36
density difference 127
density stratification 312
depositional fans 273
devitrification 478
devitrified 163
diapirs 306
differential thermal analysis 635
differential thermal gravimetry 635
differentiation process 186
dike 33, 81, 118, 160, 302, 426, 522
dike emplacement 317
dike height 308
dike intrusion 82
dike model 527
dike opening 527
dike propagation behaviour 302
dike swarm 123
dike thickness 307
dike volume 528
dikes -growth of blade-like dikes 305
direct current plasma (DCP) 179
displacement 247, 528
distal area 325
distribution coefficients 219
distribution of stress 413
dome 205, 449
dome collapse 176
dome gases 355
doming 259
downed timber 141, 533
drainage 175
dry pyroclastic surge 138
dry-tilt technique 228
dune structures 329
dust fallout 59
dykes 160

earthquake 155, 227, 247, 317, 507, 603
effusive activity 335
elastic half-space 260
elastic model 119
electron microprobe analyses 223, 586
electronic distance meter 522
elutriation clouds 281
emergency planning 543
emplacement process 348
en echelon basins and ridges 603
en echelon fault zones 445
en echelon offsets 435
encrustation mineralogy 175
energy dispersive X-ray analysis 175
enrichment factor 367
entrainment regime 130
environmental factors 229
equilibrium mixtures of dome gases 358
erosional unconformity 274
eruption 227, 522
eruption clouds 63
eruption column 58, 176, 271
eruption cycles 325
eruption frequency 602
eruption scenario 626
eruption style 515
eruptive activity 508
eruptive chronology 508
eruptive history 186, 440
eruptive mechanism 273
excess argon 209
exit pressure 518
exit velocity 518
expansion model 523
explosion crater 175
explosive activity 401
explosive blast -effects of in humans 533
explosive interaction 334
explosive silicic eruptions 296
extensional stress 299
extensional tectonism 247
external water 41, 280

fallout 167, 429
-ash 334
-lapilli beds 34
-of mud 538
-ratio of 325
fall lapilli beds 34
falloff -rate of 325
famine 57, 532
fan delta 160
faulting 603
faults -geodetically monitored 311
faults 202, 445
Fe-albandite 629
feeder dike 32
feldspar contamination 598
ferrohedenbergite 192
fiamme 200
fine particle, decay of 579
fission track 475
fissure 175, 302, 413
fissure eruption 83
fissure shape 515
fissure vent 619
fissure width 518
flank lava flows 286
floating rafts 169
flood velocity 144
flood 1, 138
floodwater 140
flow body 325, 326
flow boundary 147
flow condition 515
flow depth 383
flow dynamics 615
flow head 325
flow regime 133
flow transformation 140, 153
flow unit boundary 326
flow unit 271
flow velocity 615, 636
flow zone -channelized 533
flow zone -direct 533
fluid accumulation 262
fluid behaviour 129
fluid dynamics 417
fluid sources 388
fluid-dynamical experiments 127
fluorite 629
flysch 207
fractional crystallization 217
fractionation 445
fracture 401, 413
fragmentation process 334
fragmentation surface 28
fumarole condensates 175
fumarole distribution 175
fumaroles -temperature of 178
fumarole 291, 355, 579, 635
fumarolic activity 401

gabbro 99
gas 175
gas chromatography 356
gas condensate 362
gas emission 83
gas emissions -pulsating 579
gas expansion 417
gas study 355
gas-escape pipes 143
gaseous odors 534
gases -evaluation of 355
gases, toxic 541
geochemical variation 88
geodetic coverage 258
geodetic evidence 81
geodetic measurements 450
geodetic observations 302
geodetic studies 522
geodetic surveys 510
geometry of eruptive fissure 507
geometry of conduit 515
geometry of reservoir 530

geothermal activity 21
geothermometers 262, 480
glaciation 208
glacier, basal melting of 17
glacier 292
global climatic impact 57
graben 451
grain shape 335
grain size 140, 165, 334
grain size analyses 325
grain size distribution 277, 431
grain size variation 271
granulometry 36
gravitational force 383
gravity survey 309
gregoryite 629
ground deformation 255
ground layer 331
ground-tilt measurements 227
groundwater 154
groundwater supply 353
gypsum 175

$H_2O$ 114, 355
halite 175
halogen 175, 362
hawaiiian 426
hawaiian deposits 41
hawaiite 99, 187, 613
hazard assessment 286
hazard evaluation 335
heat convection 415
heat flux 263
heat shimmer 230
heat transfer 415
high-aspect-ratio ignimbrite (HARI) 325
historic records 291
historical eruptions 1
Holocene 292
homogeneous flow 516
horizontal compressive stress 314
horizontal ground deformation 522
horizontal strain 260
horizontal stress 302
horizontal stress limits, theoretical 311
hornblende 475
hornblende gabbro 607
hornblende hornfels 415
hornito 635
hot rock avalanche 16
hot spot 264
hot spring 612
hot surge debris 138
hot zone 413
human tolerance limit 542
humid tropics 227
hummocks 396
hummocky surface 207
hyaloclastite 166
hybrid 205
hybrid composition 81
hybrid lava 611
hybrid liquids 128
hybridization 399
hydration of silicic volcanic glass 479
hydraulic plunger 81
hydraulic sorting 165
hydrofracturing 247
hydrogen (D/H) 366
hydrogene chloride 175
hydromagmatic 142
hydrostatic decompression 54
hydrostatic pressure 417
hydrostatic stress 118
hydrothermal circulation 415
hydrothermal processes 263
hydrothermal system 247
hydrovolcanic activity 349
hydrovolcanic eruption 334
hyperconcentrated streamflow 139
hyperconcentrated flood flow 15
hypocenter 259

ice cap 291
ignimbrite activity 584
ignimbrite correlation 594
ignimbrite eruption 445
imbricated clasts 329
impact-sag structures 329
INAA 223
incompatible elements 208
inductively coupled plasma atomic emission spectrometry (ICP-AES) 177, 358
inflation 233
inflation pattern 510
infrared absorption 356
initial explosions 141
initial phreatic activity 61
initial pressure 518
initial eruptive phase 429
injuries serious 533
Inman sorting coefficient 36, 277
inner wall facies 32
intracaldera 193
intrusion front 134
intrusion of magma 523
intrusion rate 523
intrusion regime 132
intrusion 82, 302
intrusive to extrusive dome 159
inverse size grading 280
ion chromatography 356
ion filters 578
iridium anomaly 113
island subsidence 375
isopach maps 62, 273, 345
isothermal flow 516
isotope correlation 584
isotope enrichment 366
IVD 280

jig-saw fit 163
jökulhlaups (glacier-outburst floods) 17
juvenile clasts 31
juvenile material 59
juvenile pyroclasts 334

$^{40}$K-$^{40}$Ar ages 187, 209, 475
kinematic wave model 381
kinematic wave theory 383
kötluhlaups (catastrophic debris flows) 20

laccocalderas 110
laccolithic dome 97
lahar, volume of 17, 381
lahar 1, 138, 381, 532
-mathematical model of motion of 381
lamprophyre 400
Landsat 286
landslide 138
lapilli 31
lapilli beds 31
laser heating 584
lateral facies of ignimbrites 271
lava 97
-origin of 455
lava debris flow 19
lava dome 240
lava field 478
lava flow 16, 127, 175, 186, 228, 401, 545
lava flow texture 286
lava flow-type 626
lava flows, paired 619
lava pond 626
lava slabs 31
lava tube 615
least-squares computer modeling 91
leucitite 426
leveling 229
leveling survey 249
lightning strike 541
liquid immiscibility 629
lithic ash-fall 57
lithic inclusion 36
lithofacies 325
lithostatic pressure 247, 419
Little ice age 291
littoral 166
loading ratio 518
local seismicity 227
low strength region 507
low-aspect-ratio ignimbrite (LARI) 325
lower crust 122

mafic juvenile fragment 391
mafic lava 91
mafic magma 127, 205
magma mixing 205
magma ascent 122, 515
magma batch 127
magma body 81
magma budget 81
magma chamber 97, 414
-geometry 108
-pressure 114
-subsidiary 615
magma column 414
magma density 417
magma drainback 435
magma excursion 625
magma filled crack 118
magma mixing 89, 127, 445
magma pressure 302, 507, 515
magma reservoir 118, 239, 305, 355, 486

magma ponding 41
magma storage 522
magma supply 311
magma transport 118
magma volume 110
magma-water interaction 28, 61, 334
magma: water mass ratio 351
magmatic fluid, properties of 515
magmatic gas 247, 582
magmatic history 551
magmatic plumbing system 82
magmatic pressure 417
magmatic volatiles 426, 577
magnetite 205
main dispersal direction 58
major element analysis 61, 81
major element composition 475, 479
major element trends 217
major- and trace-element geochemistry 355
Manning-Law 384
mantle wedge 455
mass flow 438
mass flux 518
mass spectrometer 224, 482
master tube 623
MAT gas-source isotope-ratio mass spectrometer 223
maximum entropy spectral analysis (MESA) 460
mean bulk rock density of clast 438
mechanical behaviour of volcanoes 422
median diameter 277, 328
megabreccia 163
melanite 639
melilite 639
melilite-nephelinite 426
meltwater 19
metamorphic aureole 415
metasomatism 597
micro-earthquake 82
microplate 187
microprobe analysis 88
mid-ocean ridge 124
mixed-magma 391
mixing calculation 81
mixing magmas 81
mixing models 262
modal analyses 61, 477
monitoring program 228
monogenetic scoria cone 286
moraine 292
MORB 221
MORB type volcanics 560
mortality by zone 534
mortality risk 540
mud flow 15, 292
mud flow deposits 610
mud flow hazard 292
mugearite 186, 603
multiple flow deposit 284
mummification 535
muscular contraction 542

**n**atrocarbonatite 629
natrocarbonatite -alteration of 641
Nazca plate 286
$^{143}$Nd/$^{144}$Nd ratio 642
nepheline 191
nephelinite 443, 629, 641
neutron dose 481
neutron flux 481
Newtonian rheology 515
nodules 119
nucleation, homogeneous 580
nuee, cataclysmic 534
nuee, rapid death in a 538
nuee, -average velocity 533
nuee, -medical effects in 533
nuee ardentes 532
numerical model of bubble coalescence 50
numerical approach 413
nyerereite 629
Nyquist frequency 463

$^{18}$**O** 355
O isotope ratios 205, 641
oceanic intraplate volcano, internal structure of 413
offshore reef 375
olivine 81, 191, 205, 355, 391, 553
open fissure 515
open vent condition 349
Ordovician 160
orthopyroxene 205
outer wall facies 31
overbank facies 271
overbank flows 281
oxidation 32
oxidizing environment 175
oxygen fugacity 359
oxygen, lack of 534

**P**-wave 206, 262
P-wave velocity 309
pahoehoe 615, 633
pahoehoe lava tube 33
paleoaltimetry 49
paleobathymetry 49
paleochannel 271
paleoelevation 54
paleoenvirenment 166
paleogeographic reconstruction 54
paleovalley 271
pantellerite 186
parent magma 93
partial melt 220
particle radii 580
particles, ultrafine 582
particulate emission 577
Pb isotope ratio 205
peak flow 382
Pele's hair and tears 342
peralkaline trachyte 610
periclinal strike 428
phonolite 641
photoelectric activity 577
photoemission 578
photoemission chamber 578
phreatic 175, 273
phreatic activity 102, 349
phreatic fall 334
phreatomagmatic 57, 166, 273, 334, 349, 426
phreatomagmatic ash 334
phreatomagmatic assemblage 45
phreatomagmatic deposits 34
phreatomagmatic explosion 61, 643
phreatomagmatic volcano 28
pillow lava 377
pipe vesicle 52
plagioclase 81, 163, 191, 205, 391, 475, 553
plate boundary geometry 454
Pleistocene 28, 205, 613
plinian 57, 271
plinian fallout deposit 401
Pliocene/Pleistocene 186
plumbing system 240, 369, 615, 643
poisonous fumes 293
Poisson coefficient 413
Poisson ratio 120, 262
polybaric crystallization 212
porosity, measurements of 52
porphyritic 211
postdepositional feature 32
potassium feldspar 163
potential hazard 247
preventive measure 532
primary magmatic water 355
production rate of cracks 123
propagating dike 417
proximal facies 57, 272, 325, 426
pugilistic attitude 535
pumice 325, 329
pumice bed 271
pumice breccia 165
pumice cone 159
pumice fall deposit 186, 603
pyroclastic activity 159
pyroclastic apron 188
pyroclastic debris 16
pyroclastic deposit 477
pyroclastic diamict 142
pyroclastic flow 16, 61, 175, 271, 297, 325, 532
pyroclastic flow fumarole 363
pyroclastic fragmentation 165
pyroclastic surge 16, 34, 138, 391
pyrophyllite 165
pyroxene thermometer 212

**q**uartz 163, 192, 475
quartz trachyte 99

radial dyke 414
radial vent 302
Radiocarbon dating 375
Radiocarbon age 291, 607
radiometric age determination 475
rain flush deposit 34, 348, 438
rainfall 386
Raleigh fractionation equation 217
Rayleigh wave 262
reaction rim 399
reduced volcanic gases 359
REE 640
reef growth 375
refuge 536

remote extension 302
remote sensing 288
rescue, dalayed 537
reservoir formation 118
reservoir location 522
resonator 471
respiratory distress syndrome 541
resurgent dome 261
reticulite 88
reticulite pumice layer 335
reverse grading 435
Reynolds number 127
rhyolite 97, 99, 135, 159, 247, 286, 445, 475
rhyolithic pumice 326
rhyolithic tuff 109
riebeckite 193
rift triple junction 187
rift zone 81, 305, 551
rift zone, elastic properties of 302
rift zone activity 375
rift zone geomorphology 310
rift zone ridge 377
rift zone tectonics, comparison of 302
rifting 553
ring fracture 254
rods, leveling 230

sandblasting effect 538
sanidine 475
-Na-rich 586
sanidine geochronology 584
satellite image 292
satellitic shield 626
scaling analysis 127
scanning electron microscopy (SEM) 175, 395, 478
scoria 33, 399
scoria bomb 31
scoria cone 28, 293, 426
scoria fall 57
scoria fall deposit 334
sea level, rise of 375
sediment contamination 221
sediment-size terms 139
sedimentary rocks 160
sedimentary structures 167
segregation pipe 330
seismic activity 551
seismic evidence 81
seismic observations 302
seismic records 382
seismic swarms 523
seismicity 247
sellaite 629
sericite 165
shallow groundwater 45
shallow magma chamber 400
shallow summit reservoir 311
shallow water erosion 377
shear strain rate 454
shear stress 119
shear wave 262
sheetflows 138
shelter 536
shield building stage 375
shield volcano 81, 186, 334
shock flow 385
shock lung 534
shock wave 441
silicic andesite 391
silicic magma 262
silicic to intermediate magma 127
sill 160
size distribution of vesicles 49
slickenside 32
slide-slump 160
slushflow 138
SMOW 366
snow and ice perturbation 1
snow clad volcano 1, 138
snow slab avalanche 138
snowmelt swift 138
$SO_2$ emission rate 176, 355
$SO_2$ smell 538
soda alum 175
soda-rich ash 631
soft-sediment deformation 162
solidification front 50
space distribution of bubbles 51
space shuttle 286
spatter 88
spatter lava flow 437
sphene 478
spherical-source model 260
spinel lherzolite 607
spiny pahoehoe 625
spreading center 124, 603
$^{87}Sr/^{86}Sr$ ratio 486, 560, 642
Sr isotope ratios 205
stable isotope data 356
static pressure gradient 306
steady eruption 520
steady flow 383
steam-explosive fragmentation 45
strain rate 247
stratified magma chamber 136
stratified regime 130
stratigraphic components 325
stratigraphic marker 143
stratocone 299
stratosphere 63, 175
stratovolcano 105, 176, 391
stress distribution 415
stress field 118
stress regime 442
strombolian 426
strombolian activity 578
strombolian assemblage 39
strombolian deposit 31
strombolian style 334
strombolian volcano 28
subaerial rift zone 376
subaerial stage 159
subaerial volcanism 15
subaqueous eruption 377
subaqueous tuff cone 159
subducted oceanic lithosphere 371
subduction 187, 206, 286
subglacial volcanism 15
submarine stage 159
submarine volcanism 375
subsidence 451
subsidence mechanism 265
subsidence of the Andabba plain 552
subsidence rate 378
suffocating sensation 537
sulfur 175, 355
sulfur content 63
sulfur dioxide 113
summit caldera 414, 619
summit crater 286
summit deflation 523
summit emission 113
summit inflation 523
summit magma chamber 113
summit storage 334
summit tilt 618
supersonic motion 517
supply rate 247
surge activity 61
surge deposit 57, 138, 334
surge 532
surging and turbulent flow 382
surtseyan 159
sylvite 629
synsedimentary mobilization 433

tectonic setting 302
tectonism 247
tectono-magmatic activity 551
tensile stress 118, 419
tephra, reworking of 348
tephra cone 426
tephra deposit 228
tephra fall 17, 548
tephritic to basanitic composition 28
terrane 206
Tertiary 307
Tertiary clay 426
thermal area 356
thermal expansion 413
thermal injury 532
thermal stress 414
thermocouple 635
tholeiitic 215, 455, 560
three dimensional rectangular sheet model 507
tilt change 523
titanomagnetite 553
toothpaste lava 625
total-fusion method 483
trace element analyses 61, 81
trace element pattern 182
trace elements 175, 192, 205, 475, 553
trace metals 356
trachyte dome 604
trachyte pumice 602
trachyte stratovolcano 602
trachyte/peralkaline rhyolite volcano 186
trachytic texture 61
transmission electron microscope (TEM) 580
trauma from missiles 532
tree-ring analysis 63
tree-ring date 545
tremor source 460
tremor storms 460
tremor wave propagation 460
tridymite 175

trilateration measurement 508
trimline 149
tristanite 603
tsunamis 532
tube pumice 170
tube system 626
tuff breccia 429
tuff ring 28, 426
tuff 97, 159
turbidite 159, 160
turbidity current 165
turbulent flow head 331
turbulent surge 138

**U**-series-dating 375
ultramafic dike 119
uplift 202, 247, 264
uplift profiles 512
uplift volume 510
upper crust 122

**v**alley facies 275
valley-fill ignimbrite 273
vapor phase transport 184
veneer deposit 271, 326
vent pressure 522
vent rim 334
vesicle size distribution 52
vesicularity 35, 49
vesicularity determination 36
vesiculation, near-surface 615
vigorous eruption 83
violent flow 20
viscoelastic relaxation 259
viscoelastic response 262
viscosity of carbonatite 636
viscosity 127
viscosity of magma 426
viscosity ratio 133
vitric tuff 167
volatile elements 355
volatile phase, exsolution of 516
volatiles, dewpoint of 577
Volcanic Explosivity Index (VEI) 1, 63
volcanic arc 445
volcanic complex 205
volcanic debris avalanche 207
volcanic disaster planning 543
volcanic dust veil index (DVI) 57
volcanic eruptions, medical effect 532
volcanic gas 88, 533
volcanic hazard 227, 266, 401
volcanic sandstone 165
volcanic tremor 238
volcanic volatile flux 175
volcanically induced cooling 57
volcaniclastic deposits 97
volcano 413, 426
volcano activity 471
volcano activity, monitoring of 460
volcano hazard 227
volcano monitoring 286
volcano-tectonic 431
volume of eruptive fissure 512
volume of magma 186, 522
volumetric expansion 522
volumetric flow rate 615
vulcanian 57, 295, 426

**w**all-rock erosion 365
wall-rock lithics 31
water pressure 212
water vapor 580
water vaporization 178
water wave 538
water/magma mass ratio 441
wave erosion 159
weighted mean age 486
welded pyroclasic flow 603
welding 200
wet debris flow 532
wet pyroclastic surge 142
widespread ash layer 271
witherite 629
wollastonite 639

**X**-ray diffraction 175
X-ray fluorescence 177
xenocrystic contamination 486
xenocrysts 639
XRF analysis 88, 192, 223

**y**ield strength of lava 623
Young modulus 119, 413

**z**ig-zag cracks 35
zircon 478
zoned magma body 94

# List of location of volume 52 1989/1990

Aden rift, gulf of 551
Afar depression 551
Africa 603, 629
Agua de Pau 602
Ainahou Ranch 335
Akan Caldera 573
Alaska 320
Alayta 558
Aleutian Arc 175
Alftafjordur swarm 308
Altiplano 291
Ambato 292
Ambrym, Vanuatu 243
Amchitka 206
Amethyst-Washburn 258
Ampato 292
Anak Ranakah, W Flores I. 322
Anatahan Island, Mariana Is. 488, 574
Anchorage 175, 320, 410
Andabba 552
Andagua lava fields 291
Andagua valley complex 288
Andean Cordillera 288
Andes 286
Andy Devine scoria cone 563
Antapuna 298
Antarctica 116
Antaymarca 298
Antigua 409
Antilles 238
Ape canyon 139
Aragunnu Bay 162
Ardoukôba volcano 551
Arenal, Costa Rica 76, 242, 322, 409, 491, 574
Arequipa 293
Arizona 562, 565
Arroyo El Cabrito 199
Arroyo Grande 199
Arroyo Hondo 197
Asal Rift 551
Asal Series 560
Asama 574
Asia 63
Aso caldera, Japan 74, 325, 492
Augustine volcano, Alaska 176, 244, 352
Auquihuato complex 288
Austral Volcanic Zone 287
Australia 407, 445
Awakaponga 450
Azores 602

Babuyan 63
Bagana, Bougainville Island 76, 243, 321, 405, 492, 574
Bagiai cone 76
Balbi 76
Bamus, Papua New Guinea 410, 489
Banda Api, Banda Sea 76
Batur, Bali 322
Bay of Plenty 445
Beluga power plant 410
Bengunnu Point 162
Big Bend National Park 99
Bird Park 335
Bismarck Sea 159
Black Mesa 110
Bloodgood Canyon 599
Bocca Nuova 245, 406
Bogota 59
Boina 558
Bonn 272
Borah Peak, Idaho 260
Boso Peninsula, Japan 242, 404
Boston 139
Bougainville Island 76, 405
Boyd Volcanic Complex 159
Breiddalur volcano 308
British Columbia 202

Caballo Blanco 599
Caldera 201
Caliente Vent 409
California 49, 299
Callaqui, Chile 489
Calypso Mound 489
Camana 292
Canada 405
Canlaon, Philippines 243, 321
Canyon Junction 248
Cape Riva 325
Capiza 292
Carlos Arevalo 573
Cascades arc 447
Cascades of Oregon 299
Catarakt canyon 139
Ceboruco 186
Central America 181
Cerro Caliente 295
Cerro Chascon 300
Cerro Jahsaya 298
Cerro La Cuchara 192
Cerro La Horqueta 293
Cerro Nocarane 293
Cerro Pajonales 573
Cerro Peñones 293, 295
Cerro Soncco Orcco 298
Cerro Tacuna 293
Chain of Craters Road 115, 244
Chakachatna River 207
Chalahuerta 298
Chapala 187
Chiapas, Mexico 59
Chihuahua 585
Chile 20, 573
Christmas Mountains caldera complex 97
Coldwater Creek 66
Colima 186
Colima volcano, Mexico 391, 411, 490
Colombia 18, 409
Colorado 266, 585
Colorado Plateau 567
Colville Ridge 453
Cone Crater 335
Cone Peak 335
Cook Inlet 175, 405
Coromandel peninsula 453
Coromandel volcanic zone 445
Coropuna 291
Correntoso River 20
Cosigüina 57
Costa Rica 59, 76, 409, 493
Crater Lake, Oregon 325, 386
Crater Peak 205
Cupapau Point 77

D'Entrecasteaux Island, Papua New Guinea 407
Dama Ale 558
Dana seamount 376
Danakil horst 558
Davis Canyon 599
Deception Island 21
Djibuti 551
Dobu Island 407
Dogie Mountain 102
Donald Duck crater 244
Donald Mound-1987 Crater 244
Doña Ana Cauldron complex 599
Dorra 551
Drift River 321
Drift River valley 489
Dümpelmaar 427

East Eifel volcanic field 272
East Pacific 304
East Rift Zone 77, 113
Eden 160
Eifel 28, 426
El Chichon 142, 286, 538
El Laco 573
El Paso, Texas 321
El Salvador 59
Eppelsberg 272
Erta Ale 558
Ethiopia 551
Etna 245, 323, 409, 460, 490
Ettringer Bellerberg 426
Eurasia 603

Fairview Peak 260
Farallon de Pajaros, Uracas 242, 404
Firura complex 288
Fishing Bridge 248
Fogo 608
Fuego, Guatemala 391, 490
Furnas 602, 610

Guadalajara 186
Galeras, Colombia 76, 322, 493, 410.490
Gamalama, Indonesia 490
Giulia Ferdinandineo 63
Goryachye Kluchy 405
Gough 414
Graham Island 63
Greenland 64
Gregory Rift 628

Grimsvötn 20
Guadeloupe 488
Guagua Pichincha, Ecuador 488
Guatemala City 59
Gulf of Fonseca 57
Gunung Patah 244

Halemaumau lava lake 335, 619
Hat Creek Flow 51
Hauhungatahi 447
Hawaii 41, 81, 113, 123, 302, 334, 489, 507, 522, 538, 560, 574, 417, 426, 615
Hawaiian Volcano Observatory 228
Hayes volcano 206
Headland 169
Hebgen Lake 251
Heidekopf 272
Hekla 19
Hells Mesa 599
Hengill 310
Henry Mountains 106
Herchenberg volcano 426
Hiiak Crater 335
Hikurangi 445
Homer, Alaska 358
Honduras 59, 288
Hualalai 378, 622
Hualca Hualca 292
Huaynaputina 286
Huerto Vallarta 186

Iceland 19, 302
Ichinomiya 492
Indian Pond 248
Indonesia 15, 286
Irruputuncu, Chile 490
Isa Lake 248
Italy 116
Ivan Grozny, Kuril Islands 405
Izu-Oshima 267

Jamaica 59
Japan 108, 286
Jorullo 186

Ka Lae 375
Kagoshima 243
Kahuku 375
Kailiili 77, 244
Kailua-Kona 379
Kakaramea-Pihanga 449
Kalalua 82
Kalapana 306, 410, 574
Kalapana Gardens 491
Kamchatka 363, 488
Kammourta volcano 551
Kapapala 352
Kapowai 447
Karkar, N. of New Guinea 76
Karymsky 489
Kasilof 405
Katla 20
Katmai 205
Kau Desert 340
Kealakekua Bay 378
Keanakakoi 334, 335
Kelimutu, Flores I. 322
Kelut 407
Kenai 405
Kenai Peninsula 408, 489
Kerguelen archipelago 414
Kermadec Islands 489
Kick-'em-Jenny, West Indies 488
Kilauea 77, 81, 113, 123, 182, 244, 308, 334, 361, 375, 408, 410, 417, 489, 507, 522, 538, 574, 615
Kilauea East Rift Zone 322
Kilauea's Kupaianaha 406
Kingman Arizona 562
Kipoka Nene 335
Kiska, W Aleutians 492
Kliuchevskoi 407, 488
Kokoolau Crater 335
Kolbeinsey Ridge 302
Komaga-take 493
Kona 376
Koolau volcano 82, 307
Korili village 552
Kötlujökull glacier 20
Krafla 315
Krafla rift zone 308
Krakatau 63
Krufter Ofen 272
Kupaianahа 77, 113, 244, 322, 489, 616
Kupapau Point 244, 322
Kuril Islands 321
Kusatsu-Shirane, Honshu 410, 493, 574
Kyushu 321, 405

La Jancia 599
La Poruna 298
La Porunita 298
La Soufriere, Guadeloupe 227
La Soufrière, St. Vincent 537
La Voragine 245, 323, 406
Laacher See volcano 271
Lacar, Chile 410
Lagila Crater 411
Laguna de Chachas 298
Lake Bombon, Taal 538
Lake Butte 248
Lake Rotoaira 449
Lake Taupo 445
Lake Titicaca 287
Langila 408, 493, 574
Langila, New Britain 76, 231, 243, 489
Las Cortaderas 293
Las Cuevas ash 190
Las Navajas 186
Las Pilas 491
Lascar, Chile 489
Le Hardys Rapids 247
Lemitar 599
Lengai 642
Lesser Antilles 488
Lewis Falls 248
Little Christmas Mountain 102
Llaima Chile 19, 409, 488
Loihi Seamount 488
Lolco River 76, 244, 406
Long Valley Caldera 77, 244, 264, 323, 406, 490
Lonquimay 76, 244, 320, 406, 489
Lozada 201
Lua Manu Crater 335
Lummerfeld Maar 426

MacKenney Crater 409, 573
Madison Junction 248
Makaopuhi crater 82
Makotuku 382
Mammoth Mountain 77, 323, 406, 490
Mammoth-Norris Corridor 263
Manam, Bismarck Sea 76, 243, 321, 405, 574
Manda Hararo 558
Manda-Inakir rift 551
Mangakatote 447
Mangakino 447
Manganui river 382
Mariana Islands 242, 404
Marion 414
Maroa 447, 452
Martinique 142, 488
Maruyama 82
Masailand 630
Masaya's Santiago Crater 491
Mauna Iki 619
Mauna Kea 619
Mauna Loa 50, 302, 375, 615
Mauna Ulu 114, 310, 616
Maungaongaonga 447
Mayor Island 202, 445
Mazama 62
Mbuelesu 243
Mendig Fan 273
Mendig paleovalley 272
Merapi 322, 361, 460
Merrimbula Group 160
Mid-Atlantic Ridge 302
Minami-dake 321
Minnesota 483
Mirror Plateau 263
Mogollon-Datil volcanic field 584
Momotombo 491
Mont-Serrat 58
Montpellier 553
Motuhora, Whale Island 451
Moussa Ali marginal volcanic center 552
Mt. Dawson 407
Mt. Dome 52
Mt. Edgecumbe 447
Mt. Erebus 116, 489
Mt. Etna 43, 116, 127, 577
Mt. Hood 15
Mt. Lamington, Papua, New Guinea 286, 537
Mt. Lamonai 407
Mt. Mazama 62
Mt. Pelée 142, 535, 622
Mt. Pond 22
Mt. Rainier 22
Mt. Royal Gabbro 180
Mt. Ruapehu 381
Mt. Spurr 205
Mt. St. Augustine 175, 205, 393
Mt. St. Helens 1, 66, 69, 71, 74, 138, 178, 227, 242, 280, 320, 361, 391, 404, 414, 490, 532, 545, 566
Mt. Vesuvius 142

uddy River 142
yrdalsjökull 20

aka-dake's Crater 321, 405
apau crater 83
avidad 406
avidad cone 76
avidad Crater 244
azca ridge 286
evada 260
evado 391
evado Ambato 292
evado Coropuna 291
evado del Ruiz 1, 154, 227, 244, 322, 405, 406, 490, 539, 574
evados Casiri 296
evados de Chachani 293, 298
evados Firura 291
evados Solimana 291
ew Mexico 223, 475, 584
ew South Wales 159
ew Zealand 21, 286, 325, 445, 489
gatamariki 449
gatoro basin 452
icaragua 57, 296, 491
imı II valley 573
orris junction 248
orth Fork Toutle River 17, 69, 71, 139
orth Island 445
orth Pacific 304
orthern Hemisphere 63
orthland 446
W Mexico 186

ahu 82, 307
coña canyon 292
hakune 447
iau Volcano 407
kada 511
kareka rhyolites 452
kataina 447, 451
l Doinyo Lengai 77, 245, 490, 490, 628
lca, Chile 489
ld Faithful 248
rgan Mountains 599
shima 574

acaya 409, 411, 490, 573
achuca 187
ahala Ash 375
aisano Park 109
ajaros, Uracas 242
ampa de Palacio 293
apua New Guinea 76, 159, 202, 243, 267, 321, 405, 492, 574
apudo, Valparaíso 573
arinacota, Chile 400
arícutin 186
auahi Crater 88, 335
each Springs Tuff 562, 565
elican Cone 248
elican Creek 256
eru 286
hlegrean Fields 414
ico da Vara 613
ico do Cascalho 608
iton de la Fournaise 407, 414, 490
Piton des Neiges 415
Plains of Abraham 139
Poás, Costa Rica 76, 245, 411, 491, 574
Pochotitan 199
Poco Ranakah 322
Ponta Delgada 607
Poupou 322
Poupou flow 77
Povoacâo caldera 602
Pu'u O'o 77, 81, 113, 244, 310, 322, 406, 489, 522, 616
Puhi 622
Puhimau Crater 335
Puhipuhi 447
Pukeonake 447
Pukeonake-Pukekaikiore-Ngauruhoe 449
Pular, Chile 573
Pupaianaha vent 574
Puu Kamoamoa 82, 523

**Q**uebrada Guarangal 293
Quelccaya ice cap 289

**R**abaul Caldera, New Britain 76, 243, 267, 321, 332, 405, 408, 411, 489, 538
Raukumara Range 446
Real Grande 332
Red Sea 551
Redoubt, Alaska 320, 404, 489, 573
Reston 610
Reydarfjordur volcanic center 308
Reykjanes Peninsula 311
Reykyanes Ridge 302
Réunion Island 414
Rio Azu-Drift River 405
Rio Chichas 292
Rio Chili 293
Rio Colca 291, 298
Rio de la Para 295
Rio Grande de Santiago 188
Rio Majes 291
Rio Ocana 291
Rio Scale 291
Rio Sihuasi 293
Rio Tambo 295
Río Tabacón 574
Roter Berg 272
Rothenberg volcano 28, 426
Rotomahana, New Zealand 142
Royal Gardens Kipuka 406
Ruapehu 21, 74, 322, 409, 447, 489, 573
Rust Slough 410

**S**abancaya 291, 492, 574
Sakura-jima 243, 321, 405, 411, 493, 574
Salar de Arizaro 287
Salar de Atacama 287
Salar de Uyuni 287
San Juan 186, 585
San Luis de Lozada 192
Sanganguey 186
Santa Cruz 223
Santa Maraa's 409
Santa Maria 62
Santiaguito Dome 409, 490, 573
Santorini 325
São Miguel 58, 602
Sete Cidades 602
Sheep Canyon 139
Shiveluch 489
Sierra La Primavera 186
Slamet, Java 320
Smith Creek Valley 139
Snake River Plain 247
Solimana 291, 298
Solitario 97
Solitario dome 109
Soufriere, St. Vincent 227
South Canyon 599
South Coldwater Creek 69, 71,
South Fork Toutle valley 141
South Island 445
Southwest zone 113
Spirit Lake 71, 139
Spurr volcanic complex 205
St. Andrews Strait 159
St. Lucia 492
St. Pierre, Martinique 532
Straight Creek 207
Stromboli 245, 492
Surtsey 142

**T**aal 142, 243
Tambora 63
Tangiwai 382
Tanzania 629
Tanzanian rift valley 629
Tarawera 61, 452
Tat' Ali 558
Tauhara 447
Taupo 325, 447
Taupo volcanic zone 445
Taupo-Hikurangi 445
Taupo-Rotorua 447
Tauranga 452
Taylor Creek Rhyolite 475
Te Porere 382
Tepetiltic 186
Tepic-Zacoalco 186
Tequila 186
Ternate Island 76
Texas 97, 288
Thingmuli rift zone 308
Three Kings Rise 455
Tigre Island 61
Tolbachik 363
Tongariro volcanic center 447
Tower Junction 248
Toya caldera 111
Tönchesberg 426
Trans-pecos 97
Tristan da Cunha 414
Trout Creek 248
Tuluman Island 159

**U**binas 295
Ukinrek Maars, Alaska 142
Ulawun, New Britain I. 76, 243, 321, 489, 574
Usu 361
Usu domes 111
Usu Volcano 110
Uwekahuna 335

Valle del Bove 410, 490, 579
Valley of Ten Thousand Smokes 182
Vatnajökull 20
Vening Meinesz fracture zone 453
Vicks Peak 599
Vienna 366
Villarrica 19
Volcan Misti 293
Volcan Ticsani 298
Volcano Island 538
Vulcano, Italy 245, 490

Waihi 447
Wake Island 404
Washington 138, 242, 404, 545
West Rerewhakaaitu 452
West Thumb 248
West Yellowstone 265
Whakamaru-source 451
Whakapapa 382
Whakatane graben 445
Whale Island 489
Whangaehu rail bridge 382
Wharekawa 447
White Island, New Zealand 74, 243, 361, 405, 451, 489
Windy canyon 139
Wingertsberg 272

Yellowstone Caldera 242, 247
Ytri-Ranga River 19

Zhupanovsky 489

Supplement to Volume 52: S1-S92 (1987)

Bulletin of Volcanic Eruptions, No. 27

Annual report of the world volcanic eruptions in 1987

Volcanological Society of Japan

International Association of Volcanology and Chemistry of the Earth's Interior

IUGG